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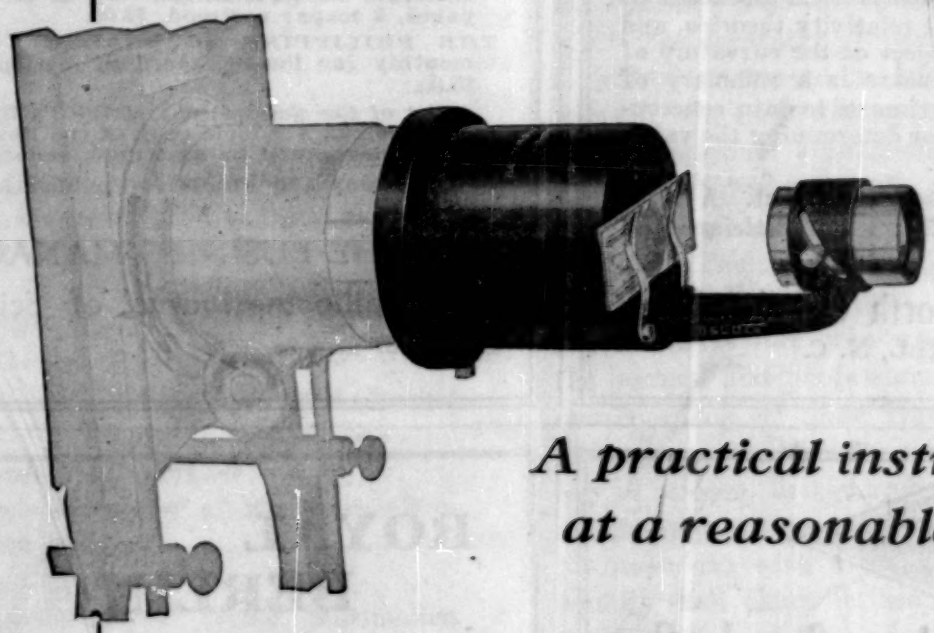

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AND
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SCIENCE

VOL. LX OCTOBER 17, 1924 No. 1555

CONTENTS

One Hundred Years of the Franklin Institute: DR. ELIHU THOMSON 343

Quetelet's Scientific Work: CONSTANT LURGUIN 351

Scientific Events:
New Medical Center in New York City; National Conference on the Utilization of Forest Products; Meeting of the American Society of Mechanical Engineers; American Association of Museums; National Research Fellowships in the Biological Sciences 352

Scientific Notes and News 353

University and Educational Notes 358

Discussion and Correspondence:
The Genus Cambarus in California: PROFESSOR S. J. HOLMES. *On Botany on the Campus:* DR. WM. T. M. FORBES. *Osmosis Demonstrations:* DR. BENJAMIN C. GRUENBERG. *Discussions at Scientific Meetings:* W. M. *Hearing and Noise:* DR. G. W. BOOT 358

Some Remarks on the Literature of Rust Fungi: PROFESSOR M. A. CARLETON 360

Laboratory Apparatus and Methods:
Material for Demonstrations of Accessory Chromosomes: ROBERT L. KING 362

Special Articles:
The Relative Reaction of Living Mammalian Tissues: DR. PEYTON ROUS. *Synthesis of Higher from Lower Hydrocarbons:* DR. S. C. LIND AND D. C. BARDWELL. *A Source of Nicotine for Insect Control:* D. E. HALEY, F. D. GARDNER AND R. T. WHITNEY 363

The Western Psychological Association 366

Science News x

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ONE HUNDRED YEARS OF THE FRANKLIN INSTITUTE[1]

As honorary chairman of the centenary celebration committee of the Franklin Institute, I have been appointed—with no subject assigned—to address you, a circumstance which permits me to deal generally with the past period of one hundred years of the life of the institute. Before doing this, I should like to refer briefly to the significance of such an occasion as this, the bringing together of so much scientific talent and eminence in research as is evidenced in the names of the speakers who are to address the sections, according to the carefully prepared program. The institute is indeed fortunate in having on the list not only many of the most distinguished in our own land, but also exceptional representation from over the seas, the whole forming a body of scientists and engineers such as is seldom if ever brought together on like occasions. The impressive list of representatives of universities and colleges everywhere, the body of leaders in science who are listed as delegates from the learned and professional societies and the numerous company of those from the great industrial organizations together form a gathering of high standing in science, in research and in the technical work which characterizes the age in which we live.

One might wish to be able to add that the age is equally well characterized by the application, in all the activities of life, of at least a semblance of the scientific method of discerning truth from falsity. But there is a strong survival of prejudice, of bigotry and of medieval ignorance in relation to the simple facts of life and existence in this world of ours; a clouding of mind only to be removed by more universal teaching of scientific principles, not alone in physics and chemistry, but in such subjects as biology and its kindred branches, in economics and even in politics and government. The advanced medical investigator still has to deal with the unreasoning prejudice of the anti-vivisectionist, it may be, or vaccinationist, or other anti-what-not, and the usual quackery to be found in the fanciful names for fanciful practice. The naturalist is even at this day threatened, in his conclusions and teaching, by the anti-evolutionist and his kin.

Fortunately, the more fundamental studies of physics, chemistry and the mechanic arts are not so banned or obstructed. The beneficial results are more immediate or direct, and less likely to cast doubt on the

[1] Address at the Centenary Celebration of the Franklin Institute, Philadelphia, on September 17, 1924.

truth of dogma of any kind. Yet we have among us many who have blamed scientific developments for much of the terrible war we have so recently passed through, forgetting that a simple, short bar of that most useful of all metals, steel, can, by the simple act of sharpening one end thereof, be converted into a very dangerous weapon; but without the hand and mental resolve to wield it, how harmless! We will eliminate war, that horrible specter which menaces civilization, when we, through understanding, unite the souls of men in the conquest of nature by science, which holds out limitless possibilities in every direction and when we obliterate greed, dishonor and bitterness—even that of religious differences—from men's minds; and when we substitute for these evils candor and generous regard, with a passion for the real truth of things in our relations in life.

It is through the ideals and work of such organizations as the Franklin Institute that we may look for at least a part of this harmonizing process. Institutions of learning, and learned bodies in general, can legitimately have such ideals as a general object, though perhaps it may be necessary for some of them, a little hide-bound in ancient lore, to moult at least a portion of their long-worn integument and grow a new and more modern covering.

However all this may be, the ever-growing unity of science in all its departments, the interdependence of its advances and the mutual aid which one department can and must give to another, is of great significance for the future.

It has appeared to me that it would be well at this time briefly to review the origin of the institute one hundred years ago and its activities in the century past.

THE FRANKLIN INSTITUTE

In addressing this distinguished gathering on the subject of our Franklin Institute and the services it has rendered to scientific progress and public instruction during the past hundred years, I shall be unable to present more than a mere outline of the activities which it has sponsored; the researches which it has through so many years carried on or assisted; its influence upon education and the outgrowth thereof—its broad fostering of the mechanic and technical arts, including its drawing and architectural schools, its assistance to governmental work; its encouragement to invention and discovery, and to inventors themselves; its free library, of so great value for reference; its notable and successful exhibitions; its long established lecture courses, its valuable committee work; and the many other avenues of effort through which it has demonstrated its inestimable worth, not only to the immediate public in Philadelphia, but to the world at large.

When organized in 1824, chiefly through the effort and interest of Samuel Vaughn Merrick, assisted by Professor Wm. H. Keating, of the University of Pennsylvania, the main object of the institute was to combine the idea of the Mechanics Institute, a type of society of which many examples were then being formed, with that of a learned society, whose membership usually included only those who had been selected because of their possessing superior knowledge in the branches to which the society was devoted.

It was recognized, in those far off days, that there was a great fund of practical information in the possession of the skilled worker or mechanic, which ordinarily was unavailable to students in the arts and sciences; and that, on the other hand, it was desirable that the more advanced knowledge of the sciences should reach those engaged in practice of the arts. Thus, the professor, the layman, the master mechanic and the workman could be brought together to the mutual benefit of all. This idea, in a broad sense, has continued through the hundred years of the history of the institute, aptly named after Franklin, of whom great versatility and deep interest in scientific discovery and in the general knowledge of his time, as well as in the practice of the arts depending thereon, was so characteristic. We may recall that Franklin, the printer, the philosopher, the statesman, was a leading spirit in the founding, here in Philadelphia, of the American Philosophical Society, a learned body, the membership in which extends throughout this country and the world. That society celebrated its hundredth anniversary many years ago.

The charter of the Franklin Institute was granted by the legislature of the State of Pennsylvania, on March 23, 1824, with the title: "An Act to Incorporate the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts." Later the means whereby this promotion was to be attained were formally stated to be: First, by the delivery of lectures on the arts and the applications of science to them; second, by the formation of a library of books relating to science and the useful arts, and the opening of a reading room; third, by examinations of all new inventions and discoveries by a committee of learned and honorable men; fourth, by the publication of a journal to contain essays on science and art, specifications of English and American patents, etc.; fifth, by holding exhibitions of American manufacturers and awarding medals to worthy workmen; sixth, by building a hall for the meetings of the institute and the use of the members; seventh, by collecting machines, minerals, materials, etc., used in the mechanic arts; eighth, by the establishment of schools for the teaching of architecture and mechanical drawing, chemistry applied to the

arts and mechanics, and, if possible, of a high school for giving young men a liberal and practical education.

This was indeed an ambitious program, so comprehensive in its scope that little could be thought of as desirable to add to it. It was characteristic of the men to whom, as leaders, the institute owes its existence. It is related of Mr. S. V. Merrick that, as a young man of twenty-one, he found himself "owner of a workshop, without a mechanical education, and with scarcely a mechanical idea." To improve this condition, he applied for membership in a local mechanics institute and was *blackballed,* as lacking the qualifications for membership. He then apparently determined to found an organization after his own ideas.

I will not attempt to detail the steps in the formation of the society, as this is already part of the records and need not be repeated here. Suffice it to say that a well-attended meeting of citizens was called on February 5, 1824, and its proceedings were eminently successful. It was presided over by James Ronaldson, Esq., who was then the leading type founder in the United States, and who continued as president of the new institute until 1841, when Mr. Merrick, so prominent in the inception of the organization, succeeded him and held the office until 1854.

A few other names may be mentioned as among the first promoters of the new society. They are Mathias W. Baldwin, Peter A. Browne, Oram Colton, Thomas Fletcher, Robert E. Griffith, Wm. H. Kneass, David A. Mason, James Rush, George W. Smith, M. T. Wickham and Samuel R. Wood. Many of these men were prominent citizens of Philadelphia in the early years of the nineteenth century. Philadelphia has always been a great industrial center, with industries and arts covering the widest range from the most delicate instruments and machines to giant locomotives and ocean liners, a range so great that it has often been said that the city had industries that could supply every need of its people and most of their luxuries.

The hall of the institute, on Seventh Street, above Chestnut, is now 98 years old, and has been made to serve its purposes through the many years which have elapsed, but only by the most careful adaptation of means to ends. It has long since been outgrown, though its older members, like myself, will always cherish for it a sense of respect, due to the many and valuable activities of which it has been the scene.

It was in that hall that I first listened to science lectures for the public, in which work without at the time suspecting it I was soon to take part. Becoming a member of the institute fifty years ago (in June, 1874, in fact), I was asked to give a course of five lectures on electricity during the season of 1876–7, which I somehow had the courage to undertake, though I was then only twenty-three. I confess that it was quite an undertaking. There was incidentally, I was told, some shaking of older heads over the choice of one so young for such a serious task. I really think, looking back, that it was these very doubts that steeled me and filled me with a resolve to do my best to win success. With apparatus, much of which was new and most of which was constructed by myself, including a small arc light dynamo —then a rarity—I set out to show that electricities of any name, static, dynamic, voltaic, electro-magnetic, magneto-electric, thermo, animal or what not, were one and the same, not differing essentially in any respect. The text-books of the day really treated of several separate electricities as if they were distinct varieties almost unrelated, except under the general title of electricity. Not to discover any vacant seats at any of the five lectures was to me a great encouragement. For several years thereafter I was on the list of lecturers at the institute, until I became at last engrossed with electric developments and removed from Philadelphia to New England in 1880.

At the last of these lectures in 1877, in reversing a Ruhmkorff coil by sending a Leyden jar discharge through its fine wire secondary, thus making it a primary, the first clue to what afterward became the art of electric welding was obtained. It may have been the first time that such an experiment as reversing a Ruhmkorff was ever tried.

It was the practice from the start of the institute to lay stress on its educational objects, and to this end it established schools for teaching, under the control of its board of managers. Professor Keating, already mentioned, was appointed professor of chemistry; Professor Robert M. Patterson, of natural philosophy and mechanics, and William Strickland, of architecture. There were appointed also committees on instruction, on inventions, on premiums and exhibitions, on the library, on models and minerals, etc.

The committee on science and the arts, which has functioned so effectively for a long period in the past, is the outcome of these early committees, at least in so far as the examination of new inventions and machines, together with recommendations of awards of merit, medals, premiums and the like, are concerned.

The institute had from the start several types of membership, and this condition still exists, but in eligibility for membership, there has been no restriction. The membership has been open to men and women, without discrimination as to race, nationality or religion, all that was needed being good character

and friendly interest in the objects for which the society was organized. Election after proposal has been left to the board of managers, who were, with the other officers, elected by vote of the members in good standing.

It might at first be imagined that such democracy in the membership would not be desirable, and that the objects of the new society would have been better carried out if the membership had been more restricted. The instructional value of the society was, however, so great that its meeting rooms and lecture hall became, as it were, the city's scientific and technical rostrum for the discussion of new advances in those fields to which it had devoted itself. Always leaning toward the technical, it became a great force in the community, the activities of which were so largely given to arts and manufactures. This was and is Philadelphia. Some sixty years ago the secretary was made a salaried officer, charged with duties of a scientific nature combined with literary work. Even at its inception in 1824, the new society took steps to establish a school for the teaching of mechanical and architectural drawing, an experiment so successful from the start that the encouragement received led to the more ambitious project of providing a school in which should be taught "all the useful branches of English literature and the ancient and modern languages." Begun in 1826 the records for 1827 show that over three hundred students were enrolled. And now comes the significant thing. These Franklin Institute schools furnished a model leading to the extension of the public school system in a few years to include such a school, a people's college. In fact, it is said that the Boys' Central High School was itself patterned after the institute schools and that the high school of the institute was thereafter abandoned as unnecessary. The institute retained, however, its drawing school, which has been for many years an important part of its activities.

To me, the facts just presented are of unusual interest, as I was graduated from the Boys' Central High School in 1870, and taught in that school as assistant professor and full professor for ten years subsequently, while at the same time occupying lectureships in the Franklin Institute, serving on its board of managers and committees and taking part in its meetings and exhibitions.

It is proper to recall at this time that, although the institute was organized to devote special attention to the mechanic arts, it has at various times and in effectual ways assisted the efforts made to elevate standards of taste in the cultivation of the fine arts as applied to the industries. The School of Design for Women, founded by the institute in 1850, was conducted by its committee for several years, until it became self-supporting.

The institute also extended its friendly cooperation and shelter during infancy to the "Pennsylvania Museum and School of Industrial Art."

Mr. Frederick Fraley, well known to older Philadelphians, as one who filled with great honor many positions demanding talent and integrity, and to whose unselfish devotion as treasurer the success in considerable part of the Centennial Exhibition of 1876 was due, has recorded much of the early history of the institute.

> The general interest created by the existence and working of the institute caused more attention to be paid to technology and to science generally, and in the year 1837 [a panic year, by the way] gave rise to a movement for the establishment of a School of Arts. The institute headed this movement and applied to the Councils of the City for a grant of a large plot of ground in West Philadelphia as a site for the buildings of the proposed school. This was promptly and cheerfully granted and the legislature was appealed to by memorials from all parts of the state to endow the school by a liberal appropriation.

This project, we are told, failed of success, but was subsequently realized in the plans of the University of Pennsylvania.

That there was need of cultivation in design and in art work generally in the country was patent enough. I think this was particularly true in machine design. It was the period when steam engines, lathes, planers and the like were built on architectural designs, including moulded cornices, fluted pillars and such like ornamentation. Locomotives were painted in all the bright colors, scarlet, chrome yellow, grass-green, etc., as agricultural machinery was later and some of it is to-day.

Besides its educational influence and activities, a most important undertaking of the institute was the establishment of its library, which in time became of a distinctive character in our country as a scientific reference library, exceptional in its accessibility and completeness. It contains to-day a great collection of the publications of principal scientific and technical bodies here and abroad, as well as the leading periodicals dealing with science and the useful arts. It also became in 1887 a public depository for the congressional district in which it is located. In this way, it was the custodian of valuable pamphlets and books which rendered much assistance later in the completion of sets of the publications of the various scientific and technical bureaus of the government.

As a patent reference library, including United States and foreign patents, the institute library has been most valuable to inventors and to others desirous of finding readily the status of ideas or inventions or to those wishing to obtain a review of an art with the

object of its improvement. So valuable a library as that of the institute badly needs space for its growth, overcrowded as it long has been. Ample protection from fire is indeed a necessity, long ago recognized as most desirable.

As a member of the institute I was fifty years ago a frequent visitor to this library, which was of great value in my early studies in the sciences and their applications. Its very atmosphere and the method of its conduct were alike stimuli to one in search of knowledge. This was many years ago, but I have no reason to believe that any of this has changed in the lapse of time during which its collections have been much enriched.

I can not leave this subject of the library without expressing the hope that it may soon be securely housed in the new institute buildings long contemplated, and that ample measures may then be taken to facilitate the use of so valuable a collection of the literature of science and technology.

Not in small measure, indeed, has the institute itself contributed to this fund of the literature of science. It has, in the publication of the *Journal of the Franklin Institute,* extended its usefulness far beyond the confines of the city and state which is its home. Appearing originally in 1826, under the title, *The Franklin Journal and Mechanics Magazine,* it was published under the patronage of the institute, and its editor was Dr. Thomas P. Jones, professor of mechanics in the institute. With the January issue of 1828, however, it was renamed *The Journal of the Franklin Institute,* which name has been retained.

In this journal it was originally intended to publish a list of patented inventions with remarks on their utility and originality. In fact, this idea was definitely carried out and remained an especially prominent feature of the journal up to the close of 1859, though the remarks on utility and originality were discontinued in 1848 when Dr. Jones, who had continued as editor from the start, died. He had in the meantime been made superintendent of the U. S. Patent Office, which fact doubtless led him to call attention to the records of patents by making them a part of the text of the journal itself.

It happens that in the publications of the Government Patent Office, prior to 1843, there was no printed account of the claims of the patents as issued, and these were listed only in the institute journal, which for the period 1826 to 1859 gave the claims as well as abstracts of the specifications of the patents issued by the United States. Thus, the journal became and remained the only source available at any time for a record of the claims of patents issued between 1828 and 1842, inclusive.

This circumstance throws a curious sidelight on the comparative crudity and incompleteness of the patent system in the United States even eighty years ago, and within the early years of the formation of the institute. It is probable that we have now in the United States a patent system which has no superior anywhere. To its liberal patent system, with its encouragement of invention, we may perhaps trace in major part the reputation for inventiveness acquired by our people. To such a system, facility in determining what is new and what is old is second cousin. The library of the Franklin Institute, replete as always with patent publications, has provided just such facility. It has also provided for the earnest student access to scientific and technical journals and other publications, in a measure not easy to overestimate.

All this valuable work has been done with a relatively small endowment and with a similarly limited library force. It is a free public reference library, containing an exceptional collection of books, pamphlets, journals, maps, charts, photographs, etc., bearing on science and its applications.

I think that it can be said truly that the journal of the institute has steadily improved with the flight of years, so that the papers published therein, largely based on the lectures and discourses at the institute itself, have reflected the general advance in science in its latest and most recondite aspects. It has achieved a most enviable reputation, both here and abroad, for the standing and general excellence of the material which appears in its pages.

This necessarily brief account of the objects and services of the Franklin Institute would be very imperfect if some allusion were not made to its function of investigation, examination and award accomplished through its committees during the century of its life.

Early in its history, a special committee of the institute made a careful investigation of water-wheel efficiency, examining the various types then known, and the results appeared in the journal. This was followed by a committee investigation of the cause of steam boiler explosions, not very uncommon in those early days. In this investigation, the committee secured the cooperation of the government, with an appropriation therefrom to defray the cost of the experiments, without, however, allowing any compensation to the members conducting them. It was volunteer work through many months and resulted in great public benefit. Allied to these boiler tests was an examination of the strength of materials used in construction, the results of which were also published fully in the journal.

A notable page in the history of the institute's activity and service is the interest elicited in the study of meteorology by lectures and essays of Professor Jas. P. Espy, leading to the appropriation by the

state of $4,000 in 1843 for the acquisition of instruments and the establishment of observing stations throughout the state of Pennsylvania. The committee on meteorology of the institute, in conjunction with a like committee of the American Philosophical Society, conducted the observations for the study of weather conditions and storms.

This early meteorological work gave rise to a theory of storms which foreshadowed in large measure the views subsequently adopted. It was a work carried on before the days of telegraphy, and was later followed by the establishment of weather bureaus in this and other countries. There is no need to speak of their value in agriculture and in commercial enterprises. In 1887, following the lead of the Franklin Institute, there was begun the Pennsylvania State Weather Service, which has been so successful in more recent years.

To mechanical engineers and machine manufacturers, the results of the work of the special committee for studying the shapes and proportions of screw threads are well known. As far back as 1865, its report was adopted by the institute. It proposed for adoption a simplified system of screw threads which shortly thereafter was adopted by the government and called "The United States or Franklin Institute Standard Thread." This system was adopted throughout the country. The records show that the same system, modified only in dimensions to suit the metric system, was reported favorably by the Associated Engineering Societies of Germany in 1887.

In 1875, an expert body nominated by the institute cooperated with the Philadelphia Water Department in considering the then present and the future water supply of the city, making an elaborate report, published in abstract in the journal at that time.

Reference should also be made to the investigation of the 1877–78 committee on dynamo electric machines, then rare; machines used in operating single arc lights. It was probably the earliest inquiry of the kind, and served to bring out much important data, as well as to reveal certain facts, before unknown, concerning the electric arc itself, and the relation of internal and external resistance of the circuits, voltage, etc., to efficiency in the utilization of driving power.

It was demonstrated for the first time that the greater the external or work resistance was, in relation to the internal resistance, of a dynamo, the higher was the efficiency, other things being equal. I had some years before this been constructing small dynamos and studying them. They were indeed rare machines in those days. Serving as I did on the committee as one of those in charge of electrical determinations, the work was to me most inspiring and valuable as a foundation for my future efforts in the field. The work of the committee preceded the appearance of the carbon filament lamp of Edison by nearly two years. The report of the committee is to be found in the May and June numbers of the journal of 1878.

About six years afterward, at the time of the institute's international electrical exhibition in the fall of 1884, the first electrical exhibition held in America, this earlier work in the electrical field was supplemented by more elaborate reports of similar scope, but the great growth of the electric lighting industry, which had taken place in the intervening years, furnished an abundance of material which only emphasized the paucity of that to which the early work was restricted. A notable feature of the work at the exhibition of 1884 was the report on the "Life, duration and efficiency of incandescent lamps."

The institute published in its journal of December, 1881, a report on "The conditions of safety in electric lighting." It is probably true that it was a first exposition of a number of conditions to be followed in the wiring of buildings and in the installation of circuits, afterward incorporated in underwriters' rules.

In the foregoing brief outlines of the long past work of some of its committees, an account which could, if there were need, be greatly extended, no mention has been made of the practically perpetual committee on science and the arts. Continued in one or another form from the very start of the institute, this committee has, up to the present, been an important factor in carrying out the original objects of the founders in 1824. At first it was a standing committee of five members, called a Board of Examiners, the duty of which was to examine and report on new and useful machines, inventions and discoveries which were submitted to them. Later the name was changed to the "Committee on Inventions." Continuing in this form and enlisting the voluntary services of members notable for their attainments in mechanics until 1834, it was then replaced by the "Committee on Science and the Arts," and at the same time its scope was enlarged. The records disclose a rather ambitious set of functions, continued for more than fifty years, the journal being much enriched by the labors of the body. This committee had been, prior to 1886, a voluntary association of members, but was reformed in that year on the elective basis, consisting of forty-five members, fifteen being elected each year. The condition of their choice was that they "shall pledge themselves to perform such duties as may devolve upon them, and to sustain by their labors the scientific character of the institute."

An important duty of the committee, calling for care and discretion, is in the awards of medals, certificates of merit and diplomas. The Elliot Cresson gold medal, named after its founder, is awarded as a

mark of recognition for inventions and discoveries of unusual or permanent value. The committee is empowered to award the "Medal of Merit" (made possible by the bequest of Edward Longstreth, at one time vice-president of the institute), also the "Certificate of Merit" and the "Diploma," according to its judgment. The "John Scott Legacy Medal and Premium" is awarded by the city of Philadelphia on the recommendation of the Committee on Science and the Arts, the action of the committee having been followed in making this award by the Board of City Trusts. It was established by John Scott, of Edinburgh, Scotland, as a recompense to ingenious men and women who make useful inventions.

This medal is not now awarded as formerly on the recommendation of the committee. Ten years ago there was established the Franklin Medal by Samuel Insull, president of the Commonwealth Edison Company, of Chicago, and the award of this medal is now esteemed the highest honor which the institute has in its power to bestow. The first Franklin Medal was awarded to Thomas A. Edison in 1915—and a later award has been made to Heike Kamerlingh Onnes, the great leader in low temperature research.

The fact that throughout a century such work has been carried on by this committee with so satisfactory results and with unwavering honesty of purpose is in itself a testimonial to the fidelity with which it has performed the tasks set for it, while the services of its members have at all times been rendered without compensation. It is most unlikely that such a record can be matched anywhere. All the members of the committee have been chosen by the institute as far as possible because of expert ability in professions or trades, eminent in their attainments and reputation. This prestige has been of the greatest value to the standing of the institute at large before the public.

In the early conception of the organization of our institute, the holding of exhibitions for showing to the public the products of industries and the advance in the mechanic arts and in technical science was made an important aim. It was thought that thereby encouragement might be given, and healthy rivalry among the exhibitors stimulated, which would result in lasting benefit to them and to the public. This was at a period when American manufacturers were in their infancy and needed encouragement to enable them to compete effectually with foreign productions. The early exhibitions appear to have been successful, and the records of them disclose interesting facts concerning the inception and growth of manufacturing in the United States. Premiums were awarded for meritorious accomplishment. To this end and to gain the confidence of the exhibitors, skilled examiners or judges were chosen for weighing the merits of the exhibits themselves. There can be no question that the conduct of these exhibitions served to increase the influence of the institute very greatly, and to inspire confidence in the public mind, as well as to stimulate a sense of loyalty and pride in the members.

These exhibitions were held either yearly or biennially up to the year 1858, and in various places available at the time. Naturally the reports and awards of premiums and medals were much prized by the recipients, while the exhibitions themselves served to nurture and encourage young and growing industries and to improve those already firmly established. In the records of the exhibitions the historian finds a rich mine of information in the accumulation of data thus brought together concerning the origin and progress of the industrial arts.

The two most notable exhibitions held by the institute were those of 1874 and 1884, the former commemorating the fiftieth anniversary of the founding of the society, and that of 1884 being distinctive in that it was the first international electrical exhibition held in America. It may be said to have commemorated the establishment of the early electric industries soon after to become of the greatest importance, not only to progress in the arts themselves, but in the development of our social system. As I have pointed out before, the great structures such as the tall and multifariously cellular buildings called skyscrapers, characteristic particularly of New York City, could not exist without three electric agencies: the electric light (gas would have made furnaces of them), the telephone, the absence of which would have been fatal in itself, and the electric elevator, a high speed vertical railway for quick passenger traffic between floors from top to street and even below street level.

I remember well the 1874 exhibition, held in the Old Pennsylvania Railroad Station at 13th and Market Streets, where the Wanamaker stores, well known to every Philadelphian, were erected soon after. It was in every sense a well-planned industrial exhibition, worthy of the institute, and served much to increase the prestige of the society. I had myself been elected to membership in June of 1874, and my first duty as a member was to serve on a committee of judges of exhibits in the field of scientific apparatus, chiefly optical and electrical. It was my first experience of the kind, and being but twenty-one years old at the time, the sense of responsibility engendered is a lasting remembrance.

It was at this exhibition that the Tilghman sand blast process, which in later years became of signal importance in several arts, was shown as a novel development. I can not remember that a single dynamo generator of electricity formed part of this exhibition, excellent as the showing was in many

departments of manufacture, machinery and the inventions of the time. Yet, in less than ten years from 1874, there had come into existence systems of arc and incandescent electric lighting, destined to revolutionize the whole art of illumination.

At the Centennial Exhibition of 1876, there were, as I remember, only two types of dynamos displayed, the Gramme and Wallace-Farmer, the latter of which soon disappeared after the Franklin Institute Committee's tests of 1877–8 had shown its very low efficiency as compared with the Gramme dynamo, and after the causes of that inefficiency had been pointed out by the committee. In less than two years, or in 1879, there appeared the series arc lighting systems of Brush, of Cleveland, the Thomson-Houston series system, with its automatic regulation, in Philadelphia, the Weston system in Newark, N. J., and others, and these several systems were in use that year in a number of places for the lighting of spaces to which the arc lamp was best adapted. The principles of dynamo construction and operation began to be fairly well understood by those who were connected with their design.

At the very close of 1879, Edison announced the incandescent lamp with its carbon filament, sealed bulb and high vacuum, and made the first showing of a few such lamps at Menlo Park, N. J. Central stations for arc lamp distribution in cities were beginning to be established, and a year or two later, the Pearl Street Station, the first for the distribution of incandescents on the Edison plan, was established in New York. This was followed a year later by the improvement known as three wire distribution, which was first installed in a lighting station in the city of Brockton, Mass., in 1883. This brings us close to the important institute exhibition, entirely electrical in character and international in scope, which was opened in the fall of 1884. This exhibition was not only an excellent display of the latest developments in the larger electrical applications, but it served to bring together the scientific men here and abroad in a notable congress, their meetings and discussions adding greatly to the knowledge of the principles of the new industry. My own first meeting with Sir William Thomson, afterward Lord Kelvin, the centenary of whose birth was celebrated in London in July last, occurred at these meetings in 1884. Along with Sir William Thomson were scientific men of international reputation such as Lord Rayleigh, Professor Silvanus P. Thompson, Wm. H. Preece, Professor Geo. Forbes, Professor W. A. Ayrton, and others. Professor Forbes I had the pleasure of meeting in London lately, and he is the only survivor of these named. Of our own country, there may be mentioned such names as Professor Henry A. Rowland, Professor Geo. F. Barker, Simon Newcomb, Professor C. F. Brackett, of Princeton, Professor F. Willard Gibbs, Professor John Trowbridge, Professor Charles A. Young, and others of high standing in science at that time. None of these now survive.

The several international electrical congresses, which have generally been held in connection with the larger international exhibitions, have had for their principal end the establishment of uniform definitions, designations and values for the fundamental units, such as the ohm, the volt, the ampere, the henry, etc., and it is owing to these bodies that not only the names, but the values and methods of determining such values have become uniform throughout the world. At the International Electrical Exhibition of 1884, there was organized an Electrical Congress, the first of its kind in America, followed later by the important gathering of international delegates at the World's Fair in Chicago, in 1893, and still later by the Chamber of Official Delegates at St. Louis, in 1904. Following this international gathering, there was established the International Electrotechnical Commission, the work of which has continued uninterruptedly to the present time.

The educational value of the exhibitions has unquestionably been very great, yet such has been the advance in technology since the beginning of the present century and before, that an exhibition, even restricted in its scope, would at once become too vast and beyond the power of such a body as the institute properly to finance and organize. Hence, exhibitions of the character of those of 1874 and 1884, to be at all adequate in representation, must necessarily, it seems, be held in the future, if at all, under the auspices of governments which also furnish the financial support as in constructing suitable buildings, in installing exhibits and in providing for the many activities which are necessarily involved. The British Empire Exhibition, held in London this year, is an example of the type which must survive in the future.

These facts can not, however, dim the fame of the institute resulting from the successful conduct of the exhibitions which have characterized its past. Abundantly useful as the institute has been in the past century in furthering scientific knowledge, particularly as applied to the arts, and numerous as have been the instances of brilliant work accomplished, can we doubt that, under proper guidance and with the firm policies which have become characteristic of it, the future holds equal promise of accomplishment? It is for the public to realize the true value of the possible services it can render and accord to it proper support. Endowments such as the Bartol Research Foundation are needed, and will be more needed in

the future than in the past. The ramifications of applied science naturally increase, and the delicacy and cost of research grows, the deeper we penetrate nature's secrets. There must be an increasing corps of workers, with the increasing extent and variety of the problems presented for solution. It is to be hoped that the institute may receive generous support in the coming years, and that its usefulness in carrying out the original objects for which it was founded may not be restricted by inadequate means of provision. Those among us who are of the older generation can hardly hope to see much of its future growth, but the heritage which the younger generation has received from the past should be the stimulus to continue and increase the good work which so far has characterized the work of the institute in its various forms. While the associations which have grown up around the old hall on Seventh Street stir many emotions in many of the older members, yet it is to be assumed that not many more years will elapse before the proposed new hall and library on the new site may become a reality.

ELIHU THOMSON

GENERAL ELECTRIC COMPANY,
LYNN, MASSACHUSETTS

QUETELET'S SCIENTIFIC WORK

FIFTY years have passed since the death of one of the most remarkable men to whom Belgium has given birth, Quetelet. It is very much to be regretted that this important anniversary should have been forgotten officially. Yet we have here a fine and universally appreciated scientific reputation. Besides, it would have been an opportunity to recall the example of a life entirely devoted to science and animated by a glowing and strengthening enthusiasm.

At seventeen Quetelet took up teaching at a private college of Audenarde, a small town in Flanders. Six years after that, he took the degree of doctor of science at the University of Ghent, with a remarkable dissertation in the field of geometry. The following year he was received as a member of the Royal Academy. From 1823 on, he suggested that the secretary of public instruction should create an observatory in the southern provinces, Belgium forming at that time part of the Netherlands. This happy project was realized a few years later after much patience, perseverance and energetic effort. Quetelet, having been appointed head of the new institution, organized completely its scientific function. The attention and the appreciation of the learned world had been especially attracted to him by his statistical work. His first paper on demography: "Sur les lois des naissances et de la mortalité â Bruxelles" ("On the laws of birth and mortality in Brussels") was published in 1825. Ten years later his fundamental work: "Essai de physique sociale (sur l'homme et le développement de ses facultés)" ("Essay on social physics, concerning man and the development of his faculties") saw the light in Paris. It is a synthesis of Quetelet's statistical works. In that book, the author studies the average man, in his physical and moral aspects. This audacious theory was taken up again and completed in another work: "Du système social et des lois qui le régissent," ("Of the social system and the laws that govern it," 1848). In 1841, Quetelet was called to direct the activities of the Central Commission for statistics, of which body he soon made a highly famous institution. The last years of his life were devoted to an active and fruitful participation in the work of the international meetings for statistics, and to several works of a general character, namely to the preparation of a second edition of his "Social Physics" (1869). He died on the 17th of February, 1874.

Without being transcendental, Quetelet's mathematical work is interesting and original. His researches concerning the theory of caustics have opened the way for important work. Thanks to him the first Belgian periodical devoted to exact science was created, *La correspondance mathématique et physique* (1825). Finally, he is the author of a documentary work that is worthy of notice: "Histoire des sciences physiques et mathématiques chez les Belges" ("History of Physical and Mathematical Science in Belgium," 1864). Quetelet's activities in the field of astronomy have consisted in a particularly rich work along various lines, such as descriptive astronomy, magnetism, meteorology and terrestrial physics. It is necessary to mention especially his great work on the climate of Belgium. But his universal reputation rests, without doubt, on his statistical work. His name is closely linked to the history and the development of the science of statistics. His numerous papers on demography and his remarkable analytical and synthetical studies of statistics are important in many respects.

Quetelet was a master of statistical method. He also was its apostle. The work he accomplished in statistics is extensive and fundamental. Therein lies his real scientific merit. In a general way Quetelet's statistical doctrine can be thus characterized: to a monographical description of facts, to a systematical census of elements, he substitutes a scientific observation of the masses, a methodical survey of the groups, founded on the principles of the theory of probabilities. Thence one easily admits the fundamental idea that rules all Quetelet's statistical investigations: the statistical method is the application of the calculus of probabilities to the observation of facts. Sixty years ago this was an audacious and original doctrine. It

seems that Quetelet was right. The paper of 1845 "Sur l'appréciation des documents statistiques et la théorie des moyennes" ("On the valuation of statistical documents and the averages"), was a first step in the science called biometry to-day. On the other hand, the actual prodigious rise and the important developments of mathematical statistics justify Quetelet's idea of considering the statistical method the function of the calculus of probabilities.

For Quetelet, statistics are a science. If this is so, it is not sufficient to collect documents and numbers, taking care only to group them so as to make comparisons more easy. That is administrative statistics. There is also the more important scientific side which valuates the documents and the results, and draws conclusions from them. That is scientific, or better, mathematical statistics, to which all administrative statistics must aim. A hundred years ago, Fourier said: "Statistical researches will make no real progress until they are performed by those who have thoroughly investigated mathematical theories."

It has been rightly said that Quetelet's average man died before his author. The average man, far from being, in a way, the type of the species, is simply impossible. Cournot and Bertillon have given a justified and definite criticism of this theory of the "type." As to the average moral man, he is a pure mathematical fiction. To-day that theory is quite forgotten.

Quetelet was a great Belgian. Endowed with a superior mind, a high and clear intelligence, being a real scientist, a persevering investigator, he has given a vital impulse to the study of science in Belgium. His work is complex; it abounds in valuable and deep teachings. Quetelet was a real statistician. For more than a quarter of a century he has been an important figure in the intellectual life of Belgium. He has truly given momentum to Belgian thought.

CONSTANT LURGUIN

UNIVERSITY OF BRUSSELS

SCIENTIFIC EVENTS

NEW MEDICAL CENTER IN NEW YORK CITY

A NEW medical center, which is to cost approximately $20,000,000 and is to embody the latest developments in cooperation between hospitals, medical colleges and research institutions, is assured for New York City with the announcement by the Board of Managers of the Presbyterian Hospital of its decision to erect a building jointly with the College of Physicians and Surgeons of Columbia University at Broadway and 168th Street.

According to the New York *Times*, the structure, which will be the center of a group of buildings, will cost $10,000,000, exclusive of the land. That section to be occupied by the College of Physicians and Surgeons will cost $3,000,000. This amount has already been subscribed. The Presbyterian Hospital section will cost $7,000,000, of which $2,500,000 is available, leaving $4,500,000 still to be raised.

When the medical center is completed there will be available in one place the services of leading specialists in every branch of medicine. It is said that the institution will surpass Berlin, Vienna or any other center in Europe. This will be the first complete adaptation of the medical center idea to the needs of New York City. It is planned to include, in a well-coordinated form, every type of special hospital and institution necessary for the treatment of any patient and the training of any specialist who has to do with the protection and promotion of health.

The tentative plan was first announced three years ago. Since that time careful study of the medical centers now in operation at Johns Hopkins, Harvard, Yale and other institutions has been made by the joint administrative board.

In addition to facilities for the care of patients, the new building will provide a place for scientists to collaborate in research work, and will have the equipment for training practitioners. Thus the center will embody three branches—care, research and teaching. It also will contain a nucleus for a medical group of wider scope, and it is expected that around it will be drawn such institutions as a dental school, a maternity hospital, a children's hospital and a neurological institute.

The hospital section of the building will be directly connected with the medical college. Faculty members, who will also be on the staff of the hospital, and students observing, will thus no longer lose the time they now must spend in going between classrooms, hospitals and laboratories scattered in various parts of the city.

The private pavilion, with 125 rooms, will also be attached to the building, and the income from these rooms will be devoted to meet the cost of free work in the wards. One of the features will be private rooms to be rented to relatives and friends who wish to stay near patients.

Within a short time the Presbyterian Hospital will launch a campaign—the first public appeal it has ever made—for gifts in order to raise the $4,500,000 necessary to complete the building fund. Members of the building fund committee are Thatcher M. Brown, Cornelius R. Agnew, the Rev. Dr. George Alexander, Robert W. Carle, Henry W. de Forest, W. E. S. Griswold, Dean Sage, Johnston de Forest, Samuel H. Fisher and William Sloane Coffin.

NATIONAL CONFERENCE ON THE UTILIZATION OF FOREST PRODUCTS

SECRETARY WALLACE, of the Department of Agriculture, has issued a call for a national conference on the utilization of forest products, to take place in Washington on November 19 and 20, which will mark the first comprehensive attempt to consider the economic use of existing timber supplies in the forestry conservation program.

Premises on which conference is called

1. We are faced with the momentous problem of perpetuating a supply of forest products sufficient to meet the needs of the greatest wood-using nation in the world.

2. Our national forest policy and plans for reforestation, now in the formative stage, must be shaped so as to meet the basic requirements of use; at the same time, wood usage must be greatly modified to conform to the present under-supply, and eventually to the accomplishments possible through reforestation and protection.

3. Diminished forest resources will, within the next generation, have a radical effect on wood using practices, manufacturing enterprises and living conditions in this country. It is imperative that the existing supply be conserved and apportioned as effectively as possible.

4. Approximately two thirds of the present forest cut is lost in the processes of conversion and through inefficient use. Approximately one third of the loss is now preventable if available knowledge can be generally applied; one third is not now preventable, but continued research can probably determine how prevention may be accomplished; one third will probably remain permanently unpreventable.

5. Effective accomplishment in better utilization demands the joint efforts of federal, state and private interests in the development and execution of adequate plans for the following three types of activities: (1) application of research findings, (2) direction and coordination of economic tendencies, (3) further research.

Purpose of Conference

1. To obtain national recognition of the foregoing premises, and of the fact that better utilization of forest products ranks with forest protection and timber growing as one of three essential elements of an effective forestry program.

2. To establish a nationally representative advisory committee to assist the Secretary of Agriculture in formulating and carrying out adequate measures to insure the most efficient development and use of our forest resources.

Program of the Conference

The speakers and subjects will be selected with the following objects in view:

1. To present a comprehensive idea of the nature and extent of the present preventable wastes, how the findings of research show prevention to be feasible, and how better utilization is retarded not only by economic conditions, but by failure to apply available knowledge.

2. To present a comprehensive idea of the nature and extent of the present unpreventable wastes, and how an enlarged program of research will develop means of prevention.

3. To promote discussions of policies and measures which might be supported and executed by industrial, professional and governmental agencies, both singly and jointly, to insure the most efficient development and use of our forest resources.

4. To expedite action by the conference in creating a permanent advisory committee on utilization of forest products.

Representatives at Conference

The Secretary of Agriculture has asked all associations and organized interests concerned to select delegates to represent them at the conference. It is his desire that the conference be truly representative, and all interested are cordially urged to attend.

MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

THE forty-fifth annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, New York City, from December 1 to 4. For the third consecutive year the meeting will be held coincident with the Power Show.

The technical program includes joint sessions of the machine shop practice division of the society with the special research committee on cutting and forming of metals, the special research committee on lubrication and the management division, respectively; a session on oil burning sponsored by the power and fuels divisions and a session on the handling and storing of oil sponsored by the materials handling division.

A paper on the Zoelly Turbo-locomotive, by Dr. Henry Zoelly, of Switzerland, and a paper on the petroleum situation in the United States by Dr. Julian D. Sears, administrative geologist of the United States Geological Survey, will be included in the program.

New officers for 1925 have been elected as follows:

President, Dr. William F. Durand, Stanford University, Calif.

Vice-presidents, Professor Robert Angus, Toronto, Canada; S. F. Jeter, Hartford, Conn.; Thomas L. Wilkinson, Davenport, Iowa.

Managers, John H. Lawrence, New York City; Edward

A. Muller, Cincinnati, Ohio; Paul Wright, Birmingham, Ala.

Treasurer, William H. Wiley, New York City.

Delegates to American Engineering Council, Dr. William F. Durand, Stanford University, Calif.; Fred R. Low, New York City; Wilson P. Hunt, Moline, Ill.; I. E. Moultrop, Boston, Mass.; E. N. Trump, Syracuse, N. Y.; William W. Vareny, Baltimore, Md.; Ira Dye, Seattle, Wash.; W. S. Finlay, Jr., New York City; Dean E. Foster, Tulsa, Okla.

AMERICAN ASSOCIATION OF MUSEUMS

THE American Association of Museums has removed its headquarters from the Smithsonian Institution, Washington, to New York City. The new offices are on the 10th floor of the office building, at 2 West 46th Street, New York City. This change has been prompted by a belief that more effective service can be rendered to museums under the new arrangements.

The association is entering upon the second year of a three year period during which the financing of an enlarged program is assured. Continuance of the work beyond the limits of this trial period will hinge entirely upon the effectiveness of performance now. Inasmuch as experience of the past year has pointed to New York as the most convenient center of association activities, it has seemed imperative to establish headquarters there.

Since May 1923, the association has received the hospitality of the Smithsonian Institution, which has furnished it with office space in the old National Museum building. In leaving Washington, the officers of the association express their gratitude to the Smithsonian Institution and their feeling of reluctance in losing a part of its cooperation.

LAURENCE VAIL COLEMAN,
Secretary

NATIONAL RESEARCH FELLOWSHIPS IN THE BIOLOGICAL SCIENCES

THE Board of National Research Fellowships in the biological sciences held its fall meeting on September 6 and made the following appointments:

B. E. Gilbert, botany.
T. N. Jenkins, psychology.
W. E. Loomis, botany.
Helen Redfield, zoology.
A. M. Showalter, botany.

The next scheduled meeting of the board will come in April, 1925. Applications for consideration at that time should be in the hands of the board (office: National Research Council, Washington, D. C.) not later than the first week in March, but may be received at any time during the year prior to then.

FRANK R. LILLIE, *Chairman*
Board of Fellowships in the Biological Sciences
NATIONAL RESEARCH COUNCIL

SCIENTIFIC NOTES AND NEWS

HARVEY SOCIETY lectures, under the patronage of the New York Academy of Medicine, for the season 1924–25, will be given as follows: October 25, Dr. W. S. Miller, professor of anatomy at the University of Wisconsin; November 15, Dr. A. V. Hill, professor of physiology at University College, London; December 6, Dr. W. Einthoven, professor of physiology at the University of Leyden; January 17, Dr. A. R. Dochez, associate professor of medicine at the College of Physicians and Surgeons, New York; Professor O. M. Schloss, professor of pediatrics at Cornell University Medical College. There will also be a lecture by Professor T. Madsen, director of the State Serum Institute at Copenhagen. Titles of the lectures will be announced later.

DR. ARCHIBALD VIVIAN HILL, professor of physiology at the University College, London, will give the sixteenth course of lectures on the Herter Foundation of the Johns Hopkins University School of Medicine, as follows: October 16, "The dynamics of muscular activity;" October 17, "The heat-production of muscle;" October 20, "The chemical changes accompanying muscular activity;" October 21, "The recovery process after exercise in man."

THE faculty of medicine of Harvard University has announced two lectures, to be given under the Edward K. Dunham lectureship for the promotion of the medical sciences on October 21 and 22, by Willem Einthoven, professor of physiology at the University of Leyden, on "The relation of the mechanical and electrical phenomena of muscular contraction with special reference to cardiac muscle."

DR. EDWARD HART, dean of the Pardee scientific department of Lafayette College, has been given the title of professor of chemistry emeritus. Dr. Hart's connection for fifty years with the Lafayette College faculty is now being celebrated.

DR. HARVEY CUSHING, professor of surgery at the Harvard Medical School, has been elected a member of the Medical and Surgical Society of Bologne.

DR. DOUGLAS W. JOHNSON, professor of physiography at Columbia University, who represented seven American universities as exchange professor in applied science and engineering to the universities of France for the academic year 1923–24, has had conferred upon him by the French government the decoration of Chevalier of the Legion of Honor.

THE American Geographical Society of New York has presented the Serbian physical scientist, Dr. Yovan Tsviyitch, professor at the University of Belgrade and president of the Serbian Academy of Science, with a gold medal, in token of recognition of his services in the field of geography.

THE Royal College of Physicians of London has bestowed on Dr. Albert Calmette, assistant director of the Pasteur Institute, the gold medal and the Weber-Parkes triennial prize for the best original article on tuberculosis.

CAPTAIN EDWARD KIDSON, formerly of the department of terrestrial magnetism of the Carnegie Institution, now with the Commonwealth Meteorological Bureau at Melbourne, Australia, has received the honorary degree of D.Sc. from the University of New Zealand.

DR. M. JEAN CAMUS, professor of physiology at the Paris Medical School, has been elected a member of the French Academy of Medicine.

THE French Academy has awarded one of the Montyon prizes to Dr. Rodiet, chief of the Ville-Evrard Asylum, for his manuscript "Reminiscences of an army medical officer during the world war."

PROFESSOR H. PITTIER, connected for twenty years with the U. S. Department of Agriculture and now director of the Commercial Museum at Caracas, Venezuela, recently received from the French government the ribbon of Officier de l'Instruction publique, in recognition of his work on the botany, geography and ethnology of Central and South America.

DR. W. J. V. OSTERHOUT, professor of botany at Harvard University, has been appointed a member on the scientific staff of the Rockefeller Institute for Medical Research. He will assume his new duties on September 1, 1925.

DR. C. S. PALMER has accepted a position with the bureau of scientific research of the Institute of American Meat Packers, of which Dr. W. Lee Lewis is director. For the present, Dr. Palmer will conduct the experimental part of his work at Northwestern University.

DR. FRED W. WARD has recently accepted the position of chemist-pharmacologist in the Federal Department of Health, at Ottawa, Canada.

F. P. GROSS, formerly on the staff of the department of chemistry at Cornell University, is now connected with the Air Reduction Sales Company.

AFTER seventeen years of service, Dr. W. C. Geer, vice-president in charge of research at the B. F. Goodrich Rubber Company, Akron, Ohio, has resigned.

R. J. BLAIR, who has had charge of the work in pathology at the Forest Products Laboratories of Canada since this line of work was established in 1915, has resigned from this position in order to engage in farming at Ormstown, Quebec.

DR. CRICHTON MITCHELL, superintendent of the Observatory at Eskdalemuir of the English Meteorological Office, retired on September 1.

DR. WILHELM V. BRANCA, formerly professor of geology and paleontology at the University of Berlin, celebrated his eightieth birthday on September 9.

DR. N. H. DARTON, of the United States Geological Survey, has returned to Washington after an extended examination of the ruins of the archaic temple of Cuicuilco, twelve miles south of the city of Mexico, for the purpose of determining their age and relation to the surrounding lava flow. The investigation was made for the National Geographical Society, which is cooperating with the Mexican government in unearthing the ruins.

NEIL M. JUDD, curator of American archeology in the U. S. National Museum, who left Washington early in May to resume direction of the National Geographic Society's explorations at prehistoric Pueblo Bonito, New Mexico, has recently returned from the west. The past season, the fourth at Pueblo Bonito, proved noteworthy both as to the archeologic data collected and the amount of cultural material recovered.

DR. ALICE HAMILTON, of the Harvard Medical School, left on October 8 for Poland and Russia to study health conditions in industry there in behalf of the League of Nations, of whose health commission she is a member.

DR. J. ENRIQUE ZANETTI, associate professor of chemistry at Columbia University, has returned from abroad, where he went as a member of a special commission of chemical experts appointed by the League of Nations to examine into the present status of gas as a weapon of warfare.

DR. MORTIMER D. LEONARD, formerly associated with the United States Department of Agriculture, has returned after three months in Spain, where he studied methods of combatting the fruit fly.

A FRENCH Arctic expedition, headed by M. Jules de Payer, is to start for the polar regions at the end of next March, according to *Le Journal*. The party will proceed in a specially equipped vessel to the Franz Josef Archipelago, whence an attempt will be made to fly across the North Pole.

CAPTAIN ROBERT A. BARTLETT, the explorer, has announced plans to drift through the pack ice of

the North Pole, from Bering to Spitzbergen, 2,700 miles, in a small steamer. It is estimated it would require from three to five years to make the voyage.

DR. HANS ZINSSER, professor of bacteriology and immunology at the Harvard Medical School, delivered the address on the occasion of the seventy-eighth anniversary of Ether Day at the Massachusetts General Hospital, on October 16.

PROFESSOR S. P. L. SÖRENSEN, director of the Carlsberg Laboratory, Copenhagen, Denmark, delivered an address on October 7 before a joint meeting of the Washington Academy of Sciences and the Chemical Society of Washington, and on October 9 he lectured under the auspices of the Herter lecture fund at the Johns Hopkins University.

PROFESSOR V. BJERKNES, of the University of Bergen (Norway), will give a course of lectures at the California Institute of Technology this fall and then participate in a course of lectures and exhibit in Washington about the middle of December, at the Carnegie Institution of Washington, of which he is a research associate.

A BUST of the celebrated sixteenth century physiologist, Santorio Santorio, was recently unveiled at Capodistria at the termination of the Italian Congress of Hydrology.

PROFESSOR W. A. LOCY, head of the department of zoology at Northwestern University, has died at the age of sixty-seven years.

DR. SELIAN NEUHOF, formerly professor of clinical medicine at Fordham University Medical School, known for his work on cardiac diseases, died on October 6, aged sixty-three years.

DR. A. G. MCGOUGAN, professor of physics and head of the department of physics in the University of Saskatchewan, died on September 28.

THE American Mining Congress will meet at Sacramento, California, from September 29 to October 4, for its twenty-seventh annual convention.

THE seventh annual meeting of the American Dietetic Association was held at the New Ocean House, Swampscott, from October 13 to 16. The program was divided into four sections—administrative, educational, dietotherapy and social service, one day having been set aside for each section. In addition to the program there was a commercial and non-commercial exhibit.

THE Geneva Agricultural Experiment Station has received a "Grand diploma" from the Italian government in recognition of its work in behalf of the dairy industry of the world. The diploma was awarded at the first international dairy exhibition held at Milan.

AN appropriation of $10,000 has been made by the Boston City Council to enable Dr. W. T. Bovie, of the city's Medical Conservation Bureau, to carry on experiments with ultra-violet light in the treatment of rickets, tuberculosis and some skin diseases. The money will be used for building and equipping a laboratory on Huntington Avenue adjacent to the biophysical laboratory.

AT the University of Minnesota the corner-stone has been laid for an institute for cancer research, to be erected at a cost of $250,000.

THE United States forestry department intends to purchase 2,000 acres of burnt over plains lands in Michigan for a reforestation project. Norway pine is to be planted.

AT the autumn meeting of the Institute of Metals, the president, Professor T. Turner, announced that a donation of £1,000 had been made by an unnamed friend of the institute to meet the needs of the increasing membership. The council will consider its use as the basis of an endowment fund.

SCHOOLS of forestry are to be established at the University Colleges of Auckland and Canterbury by the New Zealand government, which will make a grant of £1,000 a year, with an additional £600 towards the cost of initial equipment.

A NEW research farm of 350 acres at Wrea Head, near Scarborough, has been placed at the disposal of the University of Leeds by Mrs. Ellis, widow of the late Hon. John E. Ellis. The farm is being used for carrying on experiments in milk production.

THE British government has decided to provide a further sum of £500,000 for agricultural education and research in addition to the funds already available for that general object, amounting to £1,000,000, under the Corn Production Acts and about £400,000 per annum from other government funds. It has been arranged that this new money will be paid over to the Development Fund by the treasury as required, and that it may be looked upon as provided for use during the next five years. The ministry is framing proposals for various schemes to be assisted from this new money. Already certain awards of grants in aid of research into specific agricultural problems have been made by the ministry for the academic year 1924–25.

A SUM of 55,000 francs has been received by the Brussels University Library from the Professor Léon Stiénon Commemoration Fund. The income will be devoted to the purchase of the principal medical periodicals.

THE Geological Survey, Department of the Interior, as a part of its work of determining the location and extent of the natural resources of the country, has

made a survey of Yampa River from Craig, Colo., to its junction with Green River, near the Colorado-Utah boundary, a distance of about 130 miles. A report has been prepared on the possibility of developing power and storing water on this stretch of the river. No power is now being developed in this stretch and, owing to the shortness of the growing season and the poor facilities for transportation, little agriculture is practiced in this region. Although the river is capable of furnishing a large amount of power, there is no market for such power at present, nor are the prospects good for a market in the near future. If, however, a demand should be created by the electrification of railroads or by the construction of a superpower system connecting several units of power with an established market, the development of power on this river would be profitable.

BUILDINGS have been completed and the required equipment obtained for the scientific investigation of distemper in dogs. Situated in England at the farm premises of the National Institute for Medical Research, near Mill Hill, the designing of the dog kennels and runs of the hospital for infected dogs and of their equipment, and the work of obtaining and managing a stock of dogs suitable for the necessary experimental work have been in the hands of Professor Buxton, working in cooperation with Major G. W. Dunkin, who has now taken his place as superintendent at the Medical Research Council's Field Laboratory. The special studies of "filterable viruses" associated with distemper have been entrusted to Dr. W. E. Gye and Dr. P. P. Laidlaw, members of the scientific staff of the Medical Research Council, with the cooperation in particular technical directions of Dr. C. C. Dobell, Dr. J. E. Barnard and others. The statistical investigation of selected outbreaks of distemper occurring in different parts of the country is being carried out under the advice of Dr. John Brownlee, of the staff of the Medical Research Council, and Dr. Major Greenwood, of the Ministry of Health.

EXTENSIVE investigations of engineering problems affecting public utilities are to be carried out by the engineering experiment station of the University of Illinois in cooperation with a utilities research committee representing several of the largest utility companies operating in Illinois, according to an announcement by W. L. Abbott, chairman of the committee and chief operating engineer of the Commonwealth Edison Company. The committee is to furnish $25,000 a year for two years, and the university will furnish scientists, laboratories and equipment. Investigations on the fatigue of structural parts will include studies of the wear on axles, fans and other moving parts. Experiments with porcelain will be carried on with a view to increasing the efficiency of insulators. Refractories for water-gas furnaces will be investigated and studies of boiler-feed-water treatment will include an examination of the effect of various waters on the structural part of boilers.

ACCORDING to *Nature*, the Ramsay Memorial Fellowship trustees have made the following awards of new fellowships for the session 1924–25, the place at which the award is tenable following the name of the fellow in each case: British Fellowship of £300 to Mr. S. W. Saunders, University College, London; Glasgow fellowship of £300 to Mr. A. Robertson, University of Manchester; Danish fellowship of £229 to Mr. K. J. Pederson, University of Bristol. The following fellowships have been renewed: Dr. S. Coffey (British fellowship), University College, London; Dr. A. Titley (British fellowship), University of Oxford; Mr. Thomas S. Stevens (Glasgow fellowship), University of Oxford; Dr. Miguel Crespi (Spanish fellowship), University College, London; Dr. J. Kalff (Netherlands fellowship), University of Manchester; Dr. H. Weiss (French fellowship), Davy-Faraday Laboratory, Royal Institution; Dr. E. Boomer (Canadian fellowship), University of Cambridge. Sir Robert Robertson has been appointed a member of the Ramsay Memorial Advisory Council in succession to the late Sir James Dobbie.

THE *Journal* of the American Medical Association states that the Clinical Bureau of Information of the New York Academy of Medicine has been collecting data from hospitals and clinics of Greater New York for a booklet for the guidance of physicians interested in the local facilities for postgraduate clinical study. The bureau has also taken over and is expanding the work started years ago by the New York Association for the Development of Postgraduate Medical Education. It plans to collect information with reference to opportunities for clinical postgraduate work in large cities of the United States, England and on the continent. Several of the foreign clinics are now regularly supplying the bureau with data as to their schedule of work and facilities.

As a needful step at this time in the program of the Lake States Forest Experiment Station for the study of tree planting, the station will start a careful survey of all the planting work that has been done in past years in Minnesota, Wisconsin and Michigan. It is felt that while the task of restoring to usefulness the 20,000,000 acres of denuded forest land in these three states is yet in its infancy, enough has already been done by various federal, state and private agencies to form a basis of very profitable study. The survey as planned will help to determine the extent to which forest planting is advisable and how it can profitably be increased. The plantations to be examined include those of the United States Forest

Service on the Michigan and Minnesota National Forests, and similar plantations by the Michigan Department of Conservation, the Michigan Agricultural College, the Forest School of the University of Michigan, the Minnesota State Forest Service, the University of Minnesota and the Wisconsin Conservation Commission.

UNIVERSITY AND EDUCATIONAL NOTES

A GIFT of $475,000 to the division of chemistry of Harvard University has been made by the family of the late E. C. Converse, of New York. The money will be used for the erection of a chemical research laboratory at the university.

YALE UNIVERSITY will receive $152,679 from the estate of Dr. Plimmon H. Dudley, consulting engineer of New York, to establish what is to be known as the Dudley professorship of railroad engineering.

BEQUESTS contained in the will of Charlotte J. Hillyer, of Hartford, Connecticut, include the following: $25,000 to Yale University; $50,000 to Trinity College; $5,000 to Roanoke College, of Salem, Va.; $2,500 to Elmira College for Women, Elmira, N. Y., and $65,000 to Smith College.

BY the will of H. L. Bridgman, regent of the University of the State of New York, who died recently, the university will receive his estate, estimated at about $15,000, after the death of Mrs. Bridgman.

PROFESSOR ALEXANDER FINDLEY, professor of chemistry at the University of Aberdeen, Scotland, has accepted an appointment as acting professor of chemistry at Stanford University during the winter, spring and summer quarters of the present academic year.

DR. FRANK E. ROSS, who has been for the past nine years a member of the staff of the research laboratory of the Eastman Kodak Company at Rochester, has been appointed associate professor of practical astronomy in the University of Chicago.

DR. NATHANIEL ALLISON, of St. Louis, has been appointed professor of orthopedic surgery at the Harvard Medical School and Dr. David Harold Walker, Boston, Augustus Lecompte professor of otology.

E. F. PHILLIPS, apiculturist of the Bureau of Entomology, has accepted a position as professor of apiculture in the New York State College of Agriculture at Cornell University. J. I. Hambleton, of the Bureau of Entomology, will have charge of the bee culture investigations of the bureau.

PROFESSOR LEON E. JENKS, who was recently in charge of the course in general chemistry during the absence of Professor Frederick E. Breithut at the College of the City of New York, has been appointed professor of chemistry at the Worcester Polytechnic Institute. Dr. M. E. Smith, chief analyst in the food and drug laboratory of the Dominion Department of Health at Halifax, has been appointed instructor in the same department.

DR. J. V. HOFMANN, for eleven years director of the Wind River Forest Experiment Station of the United States Forest Service which serves the Pacific northwest region, has resigned to accept the professorship of silviculture and forest management at the Pennsylvania State Forest School at Mont Alto, Pennsylvania.

DR. EUGENE R. WHITMORE, professor of bacteriology and preventive medicine in George Washington University Medical School, has been appointed professor of bacteriology and pathology in Georgetown University School of Medicine and pathologist to Georgetown University Hospital, Washington, D. C.

PROFESSOR THOMAS M. BAINS, JR., head of the department of mining and metallurgy of the University of Illinois, has gone to the Colorado School of Mines in Denver.

THE leave of absence granted to Dr. W. Lee Lewis by Northwestern University has been extended to September, 1925. During this period his courses will be given by Professor C. D. Hurd, formerly of the University of Illinois.

DR. F. R. GRIFFITH, JR., has been promoted to associate professor of physiology and Dr. E. C. Albritton has been appointed associate in physiology at the University of Buffalo.

DR. SAUL B. ARENSON, instructor in the department of chemistry at the University of Nebraska, has joined the faculty of chemical engineering at the University of Cincinnati.

DISCUSSION AND CORRESPONDENCE

THE GENUS CAMBARUS IN CALIFORNIA

A FEW months ago I received from Miss Pirie Davidson information concerning the presence of crayfishes in a stream near Pasadena, California. In response to my request several specimens representing both sexes were sent me for identification. An examination of the gill formula and other characters showed that the crayfishes belonged to the genus Cambarus, and the species was later identified by means of the excellent description and figures in Hagen's "Monograph of the North American Astacidæ" as *Cambarus clarkii* Girard.

This is the first time that a species of Cambarus

has been reported from one of the western states. All the other west American crayfishes are members of the genus Astacus, while all the crayfishes of the United States east of the Rocky Mountains belong to the genus Cambarus, with the exception of *Astacus gambelii*, which ranges across the divide from Utah and Idaho into Montana and Wyoming, where it is found in the upper tributaries of the Missouri River.

Cambarus clarkii has been previously reported from Texas and several other southern states, and it is an interesting fact that this is one of the species of Cambarus whose previously known range approaches most closely the southern part of California. Nevertheless, the Californian and the Texan representatives of this species are separated by a long, arid stretch of over 800 miles. This is a quite unusual discontinuity in the distribution of a species, but it is possible that other specimens may be found in some of the small streams of the intervening territory in Arizona and New Mexico. It is also possible that the forms may be artificially introduced, although crayfishes are not commonly distributed in this manner. A species of crayfish would encounter many difficulties in extending its range across the deserts which lie between southern California and Texas, unless it migrated in a period when the rainfall was much more plentiful than it is at the present time.

S. J. HOLMES

UNIVERSITY OF CALIFORNIA,
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ON BOTANY ON THE CAMPUS

PROFESSOR TRELEASE, in his article in SCIENCE for August 1, calls attention among many other interesting things to the need of introducing the embryo agriculturist to plants as they grow, and to the European botanical gardens which serve the purpose. Isn't it conceivable that something of the sort might be done under American conditions? I think any aggressive botanical department would be glad to do the work if it had any reasonable hope that the plantings would be permanent.

Here there have been a number of fine groups of native and introduced plants that have been used for such instruction. But they have no protection from the administrative authorities in charge of the campus; and even in the few years I have been here a large proportion have been either dug out with a steam shovel or buried under twenty feet of earth, sometimes to make way for something equally or more useful, but frequently merely to straighten a drive or level a piece of ground. This spring one of the two small areas of natural shrubbery on the main campus was slashed off, and most of the trees also cut down, without even the excuse of any construction on the site, but apparently merely because it was in the neighborhood of a new building that was going up. (A *dead* hickory was left standing alone.)

I wonder if there is hope of sufficient reform in grounds administration to make the building up of a collection of the necessary types of plants a possibility. I imagine conditions are no worse here than on most rural campuses. The problem on a crowded city campus will be largely of a different sort.

WM. T. M. FORBES

CORNELL UNIVERSITY

OSMOSIS DEMONSTRATION FOR BIOLOGY CLASSES

DR. CLAYBERG'S observation regarding the demonstration of osmosis set up by biology teachers (SCIENCE, LX, 100, August, 1924) that "sometimes the thing does not work," applies unfortunately over a large part of these United States. I have found teachers of all degrees of intelligence and training shy at the demonstration as usually described in the textbooks, and resort finally to the classic egg and sealing wax, which is confusing to the student rather than illuminating. The chief practical difficulty is apparently that of attaching a membrane to the funnel or thistle tube so as to leave no leaks.

The use of celloidin bags I find eminently satisfactory. Although this has been repeatedly described in technical literature, teachers seem to be afraid to try it because they were not themselves taught it in school or college. But it is easy enough after one or two trials.

This method consists of: (1) preparing the celloidin bag before the class: Pour some "newskin," celloidin dissolved in ether-alcohol, free from acetone, into a four-ounce wide-mouth bottle, dry; pour out again all you can, back into the container, rotating the bottle constantly, slowly, so as to spread a very thin layer of the celloidin over the entire inside surface; remove ether and alcohol by ventilating inside of bottle—that is, blow into it several times; after the odor of ether is gone, rinse out with water, which removes most of the alcohol; gently work out the membrane, beginning at the neck of the bottle, pouring a little water between membrane and glass—the whole skin can be removed without breaking it. (2) setting up the "artificial cell" or "root hair": Insert a No. 4 or No. 5 rubber stopper, two holes, in the neck part of the bottle-shaped celloidin capsule; insert thistle tube into one hole of stopper; pour in sirup or whatever solution you intend to use until bag is quite full and overflowing; plug second hole; suspend in water—use clamp on ringstand, holding at level of rubber stopper.

To fasten bag to stopper, I find either several windings of rubber band or cementing with fresh celloidin solution satisfactory. The thistle tube may be re-

placed with a yard or two of glass tubing to get a higher lift. This whole outfit can be set up and show a rise of several inches to a foot or more within the usual forty-five minute period. It is free of complications necessarily present in the egg or parchment; it holds the interest of the students; it simplifies the problem and facilitates understanding. And it really takes less time than the other demonstrations. Bags prepared in this way in advance may be kept indefinitely suspended in sterile water, with the rubber stoppers in place ready for instant use.

Benjamin C. Gruenberg

New York, N. Y.

DISCUSSIONS AT SCIENTIFIC MEETINGS

This is to voice the sentiments of many scientists with whom the undersigned has spoken concerning the machine-like method with which our scientific meetings are conducted. Time was and not far distant in the past when each paper was given critical examination and rarely indeed did a conclusion escape open-air discussion, with the result that erroneous conclusions did not bear the weight of conviction from having been presented to some august society and the conclusion not challenged. In the days when the Society for Experimental Biology and Medicine was enlivened by the searching criticisms of men like Lusk, Jacoby, Meltzer and others, both profit and pleasure resulted. It is common, at the present time, for the presiding officers of our societies to announce that eight minutes are available for the reading of a paper and two for discussion. The logical method would be to reverse this program.

Any attempt to limit the number of papers entails difficulties, but they are not wholly unsurmountable. If we keep clearly before us what value we expect from the reading of papers, our criterion is set. Then we may entrust to a selected group of men (or to a single member) the designation of a relatively few papers bearing the stamp of importance, or of some especial virtue such as promise, or even to further the work of some young and promising worker. There are always men who will place their own benefits above those of the majority, and they will be offended by not having their papers selected. There will always be papers embodying important factors which, because they are not evident, are passed by. However, in the long run, ten papers critically examined are preferable to double the number passed through the program like the film in a movie.

A decigram of discussion is worth a kilo of pulpwood paper required to print erroneous conclusions and faulty technique.

W. M.

Lansdowne, Pa.

HEARING AND NOISE

In the article on "Graduated amplifiers as an aid to hearing" in the June 20th number of Science appears this statement: "The fallacy that deafened persons can hear better in noisy surroundings was disposed of by Dr. Fletcher," etc.

The truth of the matter is that people who are deaf because of fixation of the foot plate of the stapes often do hear better in noisy places, as every otologist knows.

I recall one man who was so deaf I had to shout to make him hear, yet he stated that he could hear a pin drop in a boiler shop. Another patient, who was also quite deaf, said she could hear perfectly if the piano were being played.

G. W. Boot

Evanston, Illinois

SOME REMARKS ON THE LITERATURE OF RUST FUNGI

While reading various mycological publications, the writer has noticed certain errors and omissions in reference to matters of fundamental importance, to which he wishes here to call attention and also to add some comments that may be of interest, bearing upon the same or similar subjects.

On page 202 of Harshberger's text-book,[1] which, by the way, is one of the best books of its class that the writer has read, it is stated that the black stem rust of wheat (*Puccinia graminis tritici*) occurs seldom on barley, whereas it is the common stem rust of barley, as well as of wheat, in the United States. Eriksson is evidently meant to be authority for the statement, as it is repeated on page 562, and there directly credited to him. Nevertheless, in 1899 the writer published results,[2] showing that barley stem rust and wheat stem rust are the same. (This publication is not included in the bibliography of the book.) Dozens of investigators have since confirmed these results, and yet others have made this same error of statement. To state an elementary fact, that should be generally known, but apparently is not, there are in the United States (1) a form of black stem rust very common on barley and wheat, (2) another distinct form on rye and rarely on barley, and (3) a third distinct form on oats, each of these being found

[1] Harshberger, John W., "Mycology and Plant Pathology," XIII + 779 pp., 271 ills., P. Blakiston's Son & Co., Philadelphia, 1917.

[2] Carleton, Mark Alfred, "Cereal rusts of the United States, a physiological investigation," U. S. D. A. Div. Veg. P. & P. Bull. 16, 74 p., 1 fig., 4 col. pl. Bibliogr. pp. 70–73, 1899.

also on various wild grasses. This leaves out, of course, the various sub-forms of each of these that are being constantly found. In Sweden, the barley-rye form is apparently the common one on barley, rather than the barley-wheat form, probably because of the greater proportion of rye to wheat grown in that country than in the United States. Even in the latter country, the barley-rye form may be more frequent on barley to the northward, where there is proportionally more rye grown, though Fraser, in a recent publication in Canada,[3] gives it no emphasis and does not state that it is found on barley at all. A rust may specialize geographically as well as with reference to host plants. Stakman, Levine and Bailey call attention[4] to an additional instance in the fact that the oat stem rust is exceptionally virulent in Sweden. In view of these facts, and the writer supposedly having done careful work, why should other American writers follow the presentation of specialized forms proposed by Eriksson, applicable only to Sweden, rather than that proposed by him applicable to the United States?[5]

The point raised is not at all a minor one, but of the greatest practical importance, for a large share of responsibility for the spread of wheat stem rust may belong to the occurrence of this rust on barley and particularly on wild barley. Wild barley is common and widely distributed in all the Great Plains from Texas to Canada, and nearly always carries the wheat stem rust, frequently in great abundance, when growing near wheat fields. This and certain other wild grasses may especially provide a means for the over-wintering of the rust in the spring wheat district. The writer found germinable spores on wild barley near Fargo, N. D., late in November. Fraser states[6] that he is still investigating methods of over-wintering, and that he has no evidence that spring infection arises from the barberry. Several wild wheat grasses also carry the rust, of which the most important is probably *Agropyron tenerum.*[7]

[3] Fraser, W. P., "Seasonable hints," Prairie Edition, No. 26, July, 1923, p. 7, Ministry of Agriculture, Ottawa.

[4] Stakman, E. C., M. N. Levine and D. L. Bailey, "Biologic forms of *Puccinia graminis* on varieties of Avena spp.," *J. A. Res.*, 24: 1013–1018, 4 pl., 1923.

[5] It may be worth while to state here that, while the discovery of biologic specialization of rusts must be credited to Eriksson, because of priority of publication, his and the writer's investigations, covering almost exactly the same ground, were absolutely independent of each other and practically simultaneous. The writer was unaware that any other one was doing the same kind of work, until his own data were ready for the press.

[6] Anonymous, "Breeding wheat to resist rust," *Northw. Miller*, 126, 296, 1921.

On pages 191 and 561 of the same text-book above mentioned, there is much confusion and error of statement in respect to the amphispore. This spore form, discovered by the writer, is in no way identical with the urediniospore, as there stated, but, as its name implies, apparently assumes the functions of both the urediniospore and teliospore. It is quite distinct from any other known spore form of the uredinales. In the writer's own experience, there is only the one instance of its occurrence,[8] that is, in the species *Puccinia vexans* on mesquite grass, but Arthur[9] has since described other instances of its occurrence in other grass and sedge rusts. It is claimed by no one, in the writer's knowledge, that either the amphispores or the urediniospores are responsible for the over-wintering of the wheat stem-rust, as intimated in the pages above cited—not the former, because they do not occur in that species of rust, and whether or not the latter are so responsible is a leading question, the correct answer to which will be of wide interest.

In another book, written by Stevens,[10] which also the writer has found to be a good book in several respects, there are nevertheless errors, as might be expected in such a book, whoever the author. The chief error, of concern to the writer, is at bottom of page 382, where the author says, under description of *Puccinia triticina,* "This species is combined with *P. triticina,* by Carleton," in which sentence he evidently meant to say *P. rubigo-vera,* it being a typographical error. However, the entire paragraph is not clear, and, taken in connection with the author's acceptance of *P. triticina,* but not of *P. dispersa,* and his statement under *P. glumarum,* which is generally considered to be quite distinct from any other species, makes it difficult to determine what idea it is intended to convey as to these forms. It may be well to state here, for the first time, the idea of the writer as to the relationship of these two rusts, in his publication

[7] It must not be inferred from these statements that the writer is skeptical as to good results from the barberry eradication campaign, as such campaign, on the part of the U. S. Government, was initiated by him, and he, in company with Bolley, Stakman and Buller, framed the first state law (in North Dakota), since that of Massachusetts, to compel the destruction of that plant. Also, he alone (in absence of a state pathologist) drafted a similar one for South Dakota, which was approved by the experiment station agronomist, but whether or not this draft is the one later enacted as law is not yet known to him.

[8] Carleton, Mark Alfred, "Investigations of Rusts," U. S. D. A. Pl. Ind. Bull. 63, 1904.

[9] Arthur, J. C., "Amphispores of grass and sedge rusts," Bull. Torr. Bot. Club. 32, 35–41, 1905.

[10] Stevens, F. L., "The Fungi which Cause Plant Disease," VIII + 754 pp. 449 ills. The Macmillan Company, New York, 1921.

first referred to above, which was as follows: The complex previously known as *P. rubigo-vera,* having been found to include frequently two distinct species, it did not become necessary thereby to establish *two* new names where there was only *one* new species. Accepting, therefore, the name *P. glumarum* for the new species, the writer simply retained the old well-known name *P. rubigo-vera* for the common brown rust of wheat and rye, proposing, however, the two names, *P. rubigo-vera tritici* and *P. rubigo-vera secalis,* for the respective biologic forms on these hosts.

In *Botanical Abstracts* there is reference to a paper by Mains[11] on the seed carriage of Euphorbia rust, which recalls very similar experiments of the writer, reported in 1904 in his paper last above cited, pages 28–29. Not having seen the entire article of Mains, it is not known to the writer whether or not his experiments are referred to in that article, but it is true that the writer demonstrated, in careful greenhouse work, the carrying over of rust in the seed of *Euphorbia dentata,* thus proving the existence of a perennial rust in an annual host, the first time in the United States. One other case had at that time been reported from a foreign country.

As already evident from these notes, it seems to the writer a matter of the greatest importance to study the relationship of the rusts of wild grasses, and of these rusts to those on the cereals. Even where the barberry is an important factor between cereal crops, a perennial grass may receive the rust first, from which it will pass on to the cultivated cereal. However, the grass is probably of most importance in over-wintering the cereal rust. It is gratifying to note that already more attention is being given to these grass rusts than previously. Mains[12] has made a good study of Puccinia montanensis and similar species on Elymus and other grasses, and, although heteroecism is the chief subject of discussion, he brings out the important point of over-wintering, apparently unaware of the fact, however, that positive results of observations in that respect had been reported by the writer some time ago in his publication last cited. Mains says:

> The geographic distribution of *P. montanensis,* as indicated by specimens in the herbarium, is British Columbia, Wisconsin, Indiana, southward to New Mexico and southern California, while *Berberis Fendleri* (the aecial host) is limited in its distribution to the mountains of Colorado and New Mexico. Such a difference in distribution, however, would be explained, if this rust is not dependent upon its aecial stage, but is able to over-winter in the uredinial stage. Mr. Bethel has made observations in Colorado which indicate that such an over-wintering may occur there.

In 1898 the writer observed that this rust wintered in the uredo stage on the University Farm at Lincoln, Nebraska. No urediniospores were germinated, but the mycelium was vigorous and spreading rapidly, and the spring had well begun. This subepidermal rust, though not occurring on cereals, is a very interesting one, and, in mode of life, is the most similar of all rusts to *P. glumarum,* in the writer's experience. It had been under the writer's observation for a long time previously in Kansas and Nebraska, and its perennial nature suspected.

MARK ALFRED CARLETON
CUYAMEL, HONDURAS

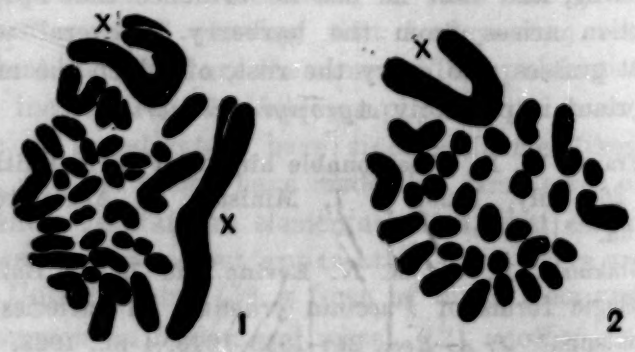
[11] Mains, E. B., "Evidence of the seed carriage of the Euphorbia rusts, *Uromyces proeminens* and *U. dictosperma,*" Proc. Indiana Acad. Sci. *1921*: 137–139, 1922.

[12] Mains, E. B., "The heteroecism of *Puccinia montanensis, P. koeleriae* and *P. apocrypta,*" *Mycologia,* 13, 315–322, No. 6, Nov., 1921.

LABORATORY APPARATUS AND METHODS

MATERIAL FOR DEMONSTRATIONS OF ACCESSORY CHROMOSOMES

IN most male Orthoptera the accessory chromosome may readily be recognized both in spermatogonial and spermatocyte divisions, but in females the paired accessory chromosomes are usually very difficult to identify. In order to find material suitable for demonstrations of the accessory chromosomes in both sexes the cells of many species of long-horned grasshoppers (Tettigoniidae) have been examined. Since such demonstrations seem to be quite widely desired for class use in zoology and for other purposes, it may be of value to report the result of this examination.



Spermatogonial cells from the testis and follicular cells of the ovary of *Orchelimum concinnum* and *Orchelimum vulgare* were found to be especially favorable. Although the number of chromosomes is rather difficult to determine, there are probably 33 in the male (Fig. 2) and 34 in the female (Fig. 1). The accessory chromosomes are V-shaped and three or four times the size of the largest autosome, as can be seen in the figures (X). Other undetermined species

of the same genus were examined and found to show very similar conditions. The genus has a very extensive distribution and may be obtained practically throughout the United States, being "very common in summer and early autumn in damp meadows and along the margins of streams and ponds."

Keys for determining material may be found in Blatchley's "Orthoptera of Northeastern America" and in Rehn and Hebard's "Synopsis of the Species of the Genus Orchelimum," Transactions American Entomological Society XLI.

In order to obtain many fine spermatogonial divisions, immature males should be killed with a few drops of xylol, the testes dissected out and fixed for three hours or longer in the following fixative, which must be freshly made up:

75 cc saturated aqueous solution picric acid, 15 cc formalin, 10 cc glacial acetic acid, 0.5 gram urea and 1.0 gram chromic acid crystals.

Wash in 70 per cent. alcohol until no longer yellow. Dehydrate clear, infiltrate with paraffin and section 7–8 μ thick. Stain in iron haematoxylin.

Ovaries should be dissected from adult females and treated as above. Since the larger eggs usually crumble when sectioned they should be removed before dehydration. Slides should be differentiated to show polar views of metaphases of dividing follicle cells.

The material is also very suitable for the demonstration of the distinctive differential behavior of the accessory chromosome in spermatogenesis. Since this element is so extraordinarily large its peculiarities in the prophases are particularly striking.

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SPECIAL ARTICLES

THE RELATIVE REACTION OF LIVING MAMMALIAN TISSUES

THE methods which have led to a comprehension of acid-base conditions in the blood are for the most part inapplicable to the study of the reaction of individual tissues in the living mammal. This field of inquiry has remained, not closed indeed, but well nigh unentered. The observations which follow indicate that the tissues in general are less alkaline than the blood, and that in some of the organs, on occasion at least, a notable acidity prevails.

Rats and mice can be vitally stained with litmus by repeated injection of it in the purified blue state. The coloration persists for weeks without manifest detriment to health. At first the whole creature becomes blue owing to the amount of indicator present in the body fluids; but soon a striking color differentiation develops. The hairless surfaces now appear violet because of a red-stained connective tissue overlain by a blue-stained epithelium. Long after the indicator has practically disappeared from the body fluids the surface epithelium, the bones, osteoid tissue, cartilage, tendons, aorta and heart valves are still diffusely blue, whereas other tissues, notably the connective tissue everywhere, the liver, pancreas and kidney are of a pronounced rosy red. The red color is almost wholly the consequence of a segregation of litmus in intracellular granules acid in character; and the amount of granular matter may become so great that the predominant reaction in the tissue when crushed is likewise acid to the indicator. In uninjured connective tissue a blue ground-work can be made out between cells laden with the red granules, whereas the parenchyma of certain of the viscera containing macrophages filled with such granules has a ruddy sheen, difficult to discriminate in the presence of these latter, which might be taken to indicate an acid state.[1] Cells with red granules dying here and there in the body are for a brief period colored diffusely blue; and local derangements within elements yet alive are signalized by a change in the tint of individual granules. The acidity of some at least of these granules in which litmus is stored is so considerable that when brom cresol green instead is deposited in them they are rendered yellow, a hue which, under controlled circumstances in the test tube, would indicate an acidity at least as great as pH 4.0.

The sodium salts of the phenol indicators stain living tissues far more rapidly, deeply and diffusely than does litmus; and several are well tolerated, as the event has shown. Mice given thymol blue, which is yellow at pH 8.0 and blue at pH 9.4, become yellow practically throughout, a fact which sufficiently indicates that the range of the indicator is too far to the alkaline side for it to be useful in the present connection. After cresol red (yellow at pH 7.2; purplish red at pH 8.4), the hairless body surfaces are reddish yellow, whereas the tissues exposed when the anesthetized animal is laid open have a clear yellow hue. The plasma of blood removed from the right ventricle into paraffined containers and under

[1] In 1913 (*J. Exp. Med.*, xviii, 183) the writer recorded the fact that some tissues grow well in plasma rendered acid to litmus through their metabolic activities; and Lewis and Felton, Fischer and Mendeléeff have since demonstrated that some survive at a pH as low as 5.5. Stieglitz (*Arch. Int. Med.*, 1924, xxxiii, 483) reports that the kidney cortex of dogs receiving azolitmin intravenously becomes red with the indicator in the course of a few minutes.

paraffin oil is by contrast yellowish red. This finding, of a less alkaline state in the tissues than in the blood, is confirmed with phenol red (yellow at pH 6.6; red at pH 7.8). The circulating fluids of mice injected with this substance are damson colored, whereas an intense yellow suffuses the tissues. With both indicators a significant phenomenon is to be witnessed during the dissection. Almost immediately on exposure to air the connective tissue stained with cresol red becomes more alkaline as shown by a change from yellow through red to rose-purple, while with phenol red not only this tissue but the cartilage, tendons and bony surfaces undergo alterations in hue that are similar in significance. Krogh[2] has shown the ease with which carbon dioxide passes through animal membranes.

Brom thymol blue, the next indicator of the series (yellow at pH 6.0; blue at pH 7.6), stains but poorly and produces an acid intoxication in mice, as is clearly attested by the yellow hue of both blood and tissues in the prostrated animals.

Brom cresol purple, which is yellow at pH 5.2, and purple at pH 6.6, stains the tissues intensely, but the dose necessary for the purpose comes close to that which is lethal. Through its use differences in the reaction of individual organs can be made out such as were foreshadowed by the work with litmus. In animals receiving it, the circulating fluids, the skin epithelium, connective tissue, bone, cartilage, tendons, aorta and heart valves are all rendered intensely purple, whereas the fatty tissue, striped muscle, liver, kidneys, lymphnodes, pancreas and certain other viscera exhibit various shades of greenish-yellow, changing to purple when alkali is applied. There can be no doubt that under the circumstances of the work a considerable acidity prevails in the last-mentioned group of organs. The color nuances to be observed in many regions of the body constitute a clear-cut tissue differentiation on the basis of differences in reaction. Pre-existing pathological changes are often sharply demarcated by colors that attest to abnormalities in the tissue reaction.

Methyl red is too susceptible to reduction for use during life; and brom cresol green, which possesses much the same range (yellow at pH 4.0; blue-green at 5.6), colors the tissues an intense blue-green, sufficient evidence that this range lies too far to the acid side for successful utilization.

The phenol indicators are excreted in large part through the bile; and the hue of the intestinal contents, which are stained in consequence, alters with the conditions at the different levels of the gut.

The information given by the indicators available at present for injection into living animals must be accepted with caution. Even the best of them is influenced by the substances with which it comes in contact; and little is known of the effects on the body of the majority of them. But the findings here set forth will serve perhaps to point the way to more conclusive studies. They emphasize the need for color methods whereby the manifold physiological differentiations within the living body can be disclosed with something of the certainty that now obtains for morphological ones.

Details of the work will appear in *The Journal of Experimental Medicine.*

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[2] Krogh, A., *J. Physiol.*, 1919, lii, 391.

DIRECT SYNTHESIS OF HIGHER FROM LOWER HYDROCARBONS[1]

IN examining the stability of gaseous ethane at normal pressure under the α-radiation of radon (radium emanation) mixed with it in a small glass sphere (1.7 cm diameter), a liquid phase appeared after the first day's radiation. Since nothing was initially present in the glass vessel except ethane confined over mercury (having contact with the ethane in a capillary connecting tube) and the infinitesimal quantity of radon (222.5 millicuries = 0.12 cubic millimeters and a pressure of 0.8 mm of foreign gas), it was evident that ethane was being converted into one or more of the higher hydrocarbons. The quantity of liquid hitherto obtained is too small for positive identification, but has about the vapor pressure of octane, which is the lowest member of the paraffin series that would form a liquid having the low vapor pressure observed at room temperature.

If the product is octane, the reaction which apparently takes place is $4C_2H_6 = C_8H_{18} + 3H_2$, which might take place in two stages with butane as the intermediate product. It is also not impossible that the product may be an unsaturated or a ring compound produced by splitting out more hydrogen.

The liquid was reddish-brown in color, most probably due to colloidal carbon, which shows that decomposition into carbon and hydrogen must also take place to some extent. Abundant hydrogen was shown to be present. After a few days, during which time the total pressure continued to increase, nothing remained except hydrogen and liquid generally distributed over the walls of the vessel in fine droplets, and forming a minute liquid column in the capillary tube at the bottom of the vessel. The pressure con-

[1] Published with permission of the Director of the U. S. Bureau of Mines.

tinued to rise, indicating the liberation of further hydrogen by the direct action of alpha particles on the droplets of liquid. No sign of solid hydrocarbons appeared.

According to ionization the reaction mechanism may be interpreted as follows. The primary reaction is the removal by alpha particles of electrons from molecules of ethane:

$$C_2H_6 = C_2H_6^+ + 1e$$

The resulting active ethane ion forms complexes by addition of ordinary neutral ethane molecules:

$$C_2H_6^+ + C_2H_6 = (C_2H_6)_2^+$$

or

$$C_2H_6^+ + 3C_2H_6 = (C_2H_6)_4^+$$

Upon electrical neutralization by free electrons (from the original ionization) hydrogen would be split out, giving butane or octane as the case may be.

The reaction appears to possess interest from several angles: (1) It appears to confirm the hypothesis of complex formation by ions proposed by one of us at the Dayton meeting of the American Electrochemical Society (Trans. *44*, 63–71 (1923)). (2) It is the first instance of a method of directly synthesizing higher from lower hydrocarbons, by α radiation. (3) It will be of interest to see whether contact catalysis will be found to produce the same reaction in larger quantity. (4) The possibility is suggested that the same complex may break down in two or more ways, giving different products. It will be important to determine how these ways may be influenced or controlled, as having a possible bearing on the cracking of hydrocarbons. (5) Since α-radiation is present everywhere in the earth's crust, it is evident that a process is at hand in nature by which lower hydrocarbons could be stepped up to higher ones, as well as broken down. However, the complete absence of free hydrogen in natural gases and petroleum remains to be explained.

A more detailed study of this and similar reactions is under way, in which it will be undertaken to determine what fraction of the primary reaction results in higher hydrocarbons and what in complete decomposition to hydrogen and carbon.[2]

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[2] The possibility of synthesizing higher from lower hydrocarbons by silent electrical discharge was long ago discovered by Berthelot (Comp. rend. *126*, 568 (1898)). Professor Boltwood (private communication) informs us that in work on the production of helium from radium he and Professor Rutherford had occasion to confine radon by a solid plug of paraffin. After several days large quantities of hydrogen were found to have been given off and the paraffin plug could no longer be melted, even by heating almost to the softening point of the glass.

NICOTIANA RUSTICA AS A SOURCE OF NICOTINE FOR INSECT CONTROL[1]

THE value of nicotine preparations for the control of aphids, leaf hoppers, red spiders and many other insects has long been recognized. The general interest in these preparations, however, has been greatly stimulated in recent years, owing to the experimental work of Smith[2] and many others on the use of natural and artificial nicotine dusts, with the result that more nicotine is used as an insecticide at the present time than ever before.

Nicotine for insecticidal purposes is derived almost entirely from stems, stalks and waste leaves of commercial types of tobacco of low nicotine content. This source of supply is dependent on the amount of tobacco wastes used for other purposes. Under the existing conditions, therefore, the cost of nicotine preparations, must, of necessity, be relatively high.

Realizing the importance of augmenting the natural supply of nicotine, the U. S. Bureau of Plant Industry, in cooperation with the Pennsylvania State College, started experimental work in 1914 on the practicability of cultivating tobaccos for their nicotine content alone. Various types of "high nicotine" tobaccos were used but were soon discarded, with the single exception of *Nicotiana rustica*, a leathery tobacco unsuited for the usual purposes of manufacturing and possessing an extremely high nicotine content. The nicotine content of these plants has since been increased by processes of selection.

In the fall of 1923, a number of carefully selected fairly mature plants of this type were sent to the Pennsylvania State College by Mr. Otto Olsen (expert in charge of tobacco investigations at Ephrata, Pennsylvania), with the request that studies be made on the whole plants relative to their nicotine content and utilization for insecticidal purposes. These plants came from Lancaster and Clinton Counties, Pennsylvania, and had received the same fertilizer treatment. Some of the plants had been topped, while others were kept free of suckers during their growing season. Several were both topped and suckered and the remaining plants were untreated. The whole plants, minus their root systems, were dried, weighed and analyzed for nicotine according to the method of Shedd.[3] The results obtained are given in the following table and are calculated on a water-free basis:

[1] Published as Paper No. 12, Department of Agricultural and Biological Chemistry, the Pennsylvania State College.

[2] Smith, R. E., "The preparation of nicotine dust as an insecticide." Univ. Cal. Pub., Bull. No. 336. 1921. pp. 261–274.

[3] Shedd, O. M., "An improved method for the determination of nicotine in tobacco and tobacco extracts." *Jour. Agr. Res.*, Vol. 24, No. 11. 1923. p. 963.